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Public Abstract

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Degree:MS

Title:Hydraulic Efficiency of a Hydrostatic Transmission with a Variable Displacement Pump and Motor

Pumps and motors are commonly connected hydraulically to create hydrostatic drives, also known as hydrostatic transmissions. A typical hydrostatic transmission consists of a variable displacement pump and a fixed displacement motor. Maximum efficiency is typically created for the system when the motor operates at maximum volumetric displacement. The objective of this research is to determine if a hydrostatic transmission with a variable displacement motor can be more efficient than one with a fixed displacement motor. Different oil temperatures, as well as speed ratios, were used in the model in an attempt to achieve these results. A work cycle for a Caterpillar 320D excavator was also created and the efficiency of the hydrostatic drive system, controlling the swing circuit, with a fixed displacement motor was compared to the efficiency with a variable displacement motor. Both multiplicative and additive uncertainty analysis were performed to determine uncertainty models that could be used to analyze the robustness of the system with feedback control applied. A PID and an Hâˆž controller were designed for a position control model, as well as velocity control. Uncertainties and performance weights were used to find the nominal stability and performance and the robust stability and performance. It was found that while it may seem obvious to achieve maximum efficiency at maximum displacement, there are some cases where maximum efficiency is achieved at a lower displacement. It was also found that for the given work cycle, a hydrostatic transmission with a variable displacement motor can be more efficient.